

The facts above recorded are somewhat novel. That they are facts so far as *Peripatus capensis* is concerned I have not the slightest doubt. Whether or no they are applicable to other animals is another question. If they are, the following considerations present themselves:—

1. Klein's view of the continuity between the reticulum of the nucleus and the reticulum of the extra-nuclear protoplasm receives striking confirmation.

2. Metschnikoff's and Lankester's views as to the origin of the gastrula and its gut receives support.

3. Herbert Spencer's view of the origin of the nervous system may perhaps not be so far from the mark as at first sight appeared.

4. The connexion between the nerve and muscles and sensory epithelial cells receives its morphological explanation, being due to a primitive continuity which has never been broken. In fact the connexion between almost every kind of tissue cell is explicable as being the primitive condition.

5. There is no essential difference between ducts with perforated cells and ducts with so-called cellular walls (inter- and intra-cellular ducts).

6. If the protoplasm of the body is really a syncytium, and the ovum until maturity in the ovary a part of that syncytium, the separation of the generative products does not differ essentially from the internal gemmation of a protozoon, and the inheritance by the offspring of peculiarities first appearing in the parent, though not explained, is rendered less mysterious, for the protoplasm of the whole body being continuous, changes in the molecular constitution of any part of it would naturally be expected to spread, in time, through the whole mass.

Shortly, these facts if generally applicable reduce the adult body to a syncytium—to a multi-nucleated vacuolated protoplasmic mass, and embryonic development to a multiplication of nuclei and a specialization of tracts in this mass.

## II. "On the Formation of the Mesoblast, and the Persistence of the Blastopore in the Lamprey." By ARTHUR E. SHIPLEY, B.A. Communicated by Professor M. FOSTER, Sec. R.S. Received October 29, 1885.

At the close of segmentation the egg of the Lamprey (*Petromyzon planeri*) forms a blastosphere. Owing to the way in which the yolk is distributed, the segmentation cavity is rather eccentrically placed. It is roofed in by several rows of small cells, while its floor is composed of a few very large cells much crowded with food yolk. The

small cells pass gradually into the larger ones at the sides of the segmentation cavity. All the cells of the blastosphere are crowded with yolk spherules, which are, however, very much smaller in the upper cells, where active division is going on, than in the more inert lower cells. The latter may be conveniently termed the yolk cells. The segmentation cavity is considerably larger than that of the frog's ovum at a similar period. The next stage in the development of the ovum is accompanied by the thinning out of the upper layer of cells, until the roof of the segmentation cavity finally consists of a single layer of cells. On this point my observations confirm those of Calberla, and are opposed to those of Max Schultze, who found a many-layered roof covering the segmentation cavity just before invagination. The layer is composed of epiblastic cells, and in this respect resembles the many-layered roof of the segmentation cavity in the frog's ovum of the same stage. The lower cells of the many-layered roof seem to pass round to the sides and floor of the segmentation cavity, so that about the fiftieth hour after fertilisation the upper half of the egg consists of a hemispherical segmentation cavity, roofed in by a single layer of cells, the lower half being solid and composed of yolk cells. Viewed as an opaque object, the upper half is of a whiter colour than the lower.

The invagination to form the mesenteron takes place in the region where the single layer of epiblast cells passes into the yolk cells. In my eggs the first trace of this invagination appeared about 130 hours after artificial fertilisation. The mouth of the invagination or blastopore is at first a wide arched slit, which subsequently narrows to a round hole. From the first sign of invagination, a cavity, the mesenteron, is present; in this the Lamprey resembles *Amphioxus*, but differs from the Frog, where the mesenteron is formed as a slit some time after the invagination has begun. It differs from *Amphioxus*, however, in the fact that the invagination is not symmetrical, being like the segmentation cavity, pushed dorsally by the accumulation of yolk cells at the lower pole. The upper layer of invaginated cells retain the character of the epiblast cells, the lower are larger, and have the characters of the yolk cells. The former lie close against the inner surface of the epiblast cells in the dorsal median line, here again differing from the Frog, where a mass of cells, which subsequently form mesoderm, lies dorsally to the invaginated cells and between them and epidermis. There is thus no mesoblast present at the dorsal rim of the blastopore, such as is found in frog's egg. During these processes the epiblastic cells have gradually enclosed the yolk cells; this appears to take place by the conversion of the outer yolk cells into epiblast cells, and takes place latest in the region of the blastopore. The mesenteron continues to deepen, and as it increases in size the segmentation cavity diminishes, and is finally obliterated. The roof and

sides of the mesenteron consist of columnar cells, in appearance very like the epiblast, against the inner surface of which it is closely pressed. The floor is composed of cells, which retain their yolk-like characteristics for a considerable time. The mesoblast now begins to appear by the differentiation of two bands of those yolk cells which lie in the angles formed by the invaginated mesenteron and the epiblast. The differentiation appears to take place from before backwards. The two bands of mesoblast are separated from one another in the dorsal median line by the juxtaposition of the invaginated hypoblast and the epiblast. They are separated ventrally by the hypoblastic yolk cells which are in contact with the epiblast over the lower two-thirds of the egg. Subsequently, but at a very much later stage, the mesoblast is completed ventrally by the downgrowth on each side of the mesoblastic plates. These proliferate cells at their edge, which grow down between the hypoblastic yolk cells, and so complete the mesoblast ventrally. The first formation of the longitudinal band appears to take place by a differentiation of hypoblastic cells *in situ*, and not by an invagination of cells.

This account of the origin of the mesoblast differs materially from that given by Scott. According to his observations, the mesoblast is derived from two sources: (1) cells which are invaginated with the mesenteron, these form the longitudinal bands; (2) the outer layer of hypoblastic yolk cells, which split off the remainder, and form the ventral sheet which completes the mesoblast on that side of the body. Since by this time the head of the embryo has raised itself above the yolk, there are no hypoblastic yolk cells in it, and consequently its mesoderm is entirely derived from the first source, whereas in the trunk the dorsal mesoderm is derived from the first source, the ventral from the second.

By the time that the mesoblastic plates become separated from the yolk cells, the neural plate becomes evident in the exterior. This extends from the blastopore as a low ridge, over two-thirds of the circumference of the egg. Its appearance is soon followed by the separation of the anterior end from the rest of the yolk.

The invaginated endoderm has extended round for more than half the circumference of the egg, and its most anterior portion is included in the head, which is by this time distinct from the rest of the embryo.

All this time the blastopore has been visible at the posterior end of the neural plate. It has been figured in this position by Schultze, who gives a very complete set of figures of the embryo viewed as a whole. The elongation of the embryo now proceeds so rapidly that the anterior end curves round over the blastopore; the posterior end is much the largest, containing all the food yolk.

Schultze, from observations upon the whole embryo, came to the

conclusion that blastopore persisted as the anus, and this view was supported by Calberla. On the other hand the later observers, who have studied the development by means of sections, have maintained Benecke's view that the blastopore closes. Scott describes the neural canal as enclosing the blastopore, and by its closure forming a neurenteric canal, which he figures. He states that the anus is subsequently formed by a protrusion of the alimentary canal against the skin, which becomes open about the twentieth day. Balfour states that the blastopore closes, and does not form the permanent anus.

My observations on the embryo as an opaque object led me to the belief that the blastopore remained open, and in this I have been confirmed by a number of series of sections taken from embryos of all stages, from the commencement of the invagination until the time when the cloaca is definitely established. At its first appearance the blastopore is situated at the posterior dorsal surface of the embryo, but by the elongation of the embryo and the formation of the tail the blastopore comes to occupy a position on the ventral surface.

Scott was of opinion that the lumen of the invaginated mesenteron persisted only in the fore-gut. This part of the alimentary canal shortly after the invagination is completed is raised with the head from the rest of the embryo. This part is therefore free from the large yolk cells, and the cells lining the mesenteron soon assume a definite columnar character, although they continue to contain yolk granules for a considerable time. According to Scott and Calberla the lumen of the mesenteron in the trunk entirely disappears, and only appears again at a much later stage. My sections, however, show that the lumen never really disappears. At its anterior end, as is just mentioned, its lining cells soon become columnar, and these extend from its blind anterior end to the posterior part of what will subsequently form the gill region. A similar change takes place at the posterior end. The cells surrounding the blastopore, and extending for some distance into the alimentary canal, very early assume a columnar character, and are in fact indistinguishable from the epidermal cells. The cells lining the mid-gut do not assume this epithelial-like character till a much later stage. The dorsal row are, however, more columnar than those on the ventral side; these latter have just the same characters as the other yolk cells.

At its posterior end the neural tube becomes solid, and this solid rod soon fuses with the posterior end of the notochord, and with a solid rod of cells which pass backwards from the hind-gut, and probably represent the post-anal gut. A little further back the mesoblastic plates join this mass of indifferent tissue; so that we have behind the anus, in a position corresponding to the front lip of the blastopore, when it occupied its primitive position on the posterior dorsal surface,

a mass of indifferent tissue, into which pass representatives of all three germinal layers. This must represent the primitive streak.

The persistence of the blastopore to form the anus has been demonstrated in the Amphibia, by Miss Johnson in the Newt, by Gasser in Alytes, and by Spencer in the Frog. The fact that it persists in the Cyclostomata appears to point to the fact that this is a primitive feature retained in those eggs which have not become much modified by the presence of a large mass of yolk. This view would be greatly confirmed if renewed observation on the development of Amphioxus should demonstrate the same fact.

III. "Researches on Myohæmatin and the Histohæmatins." By  
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M. FOSTER, Sec. R.S. Received October 19, 1885.

(Abstract.)

This paper contains an account of observations made on the spectra of the organs and tissues of invertebrates and vertebrates, which have brought to light the presence of a series of animal colouring matters which had not previously been discovered.

The name histohæmatins is proposed for all these colouring matters, and that of myohæmatin for the intrinsic pigment occurring in striped muscle, which belongs to the same series.

These pigments are not identical with any known decomposition product of hæmoglobin, and they are found in animals in whose bodies no hæmoglobin can be found.

The method of examination is as follows:—The tissue or part of organ to be examined is put into a compressorium, by means of which any required thickness can be obtained, it is illuminated by means of a large sub-stage condenser, and examined with a Sorby's microspectroscope fitted to a binocular microscope, the binocular form being preferred, as one tube is free for the observation of the specimen. The source of illumination was generally an argand gas burner, sometimes direct sunlight, sometimes a Swan lamp. The objectives of the microscope up to the one-eighth were so adapted as to enable both fields of the microscope to be fully illuminated, which is a matter of importance in dealing with small quantities of material, or in differentiating those portions of an object which give different spectra.

*The Histohæmatins.*—Examined in this way the organs and tissues of invertebrates and vertebrates present a series of spectra, which are all evidently connected with each other. From Echinoderms to man the same appearances have been found; thus there is a most striking